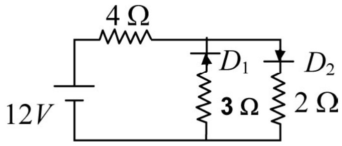
1. The energy that should be added to an electron, to reduce its de-Broglie wavelengths from 10^{-10}m to 0.5×10^{-10} m, will be
(a) four times the initial energy
(b) thrice the initial energy
(c) equal to the initial energy
(d) twice the initial energy

2. The radioactivity of an element becomes $\frac{1}{64}$ th of its original value in 60 seconds. Then the half life period of element is
(a) 5 secs (b) 10 secs
(c) 20 secs (d) 30 secs

3. The wavelength of a certain line in the x-ray spectrum for tungsten (Z = 74) is 200 Å. What would be the wavelength of the same line for platinum (Z = 78)? The screening constant a is unity.
(a) 179.76 Å (b) 189.76 Å
(c) 289.76 Å (d) 379.76 Å

4. When $_3Li^7$ nuclei are bombarded by protons, and the resultant nuclei are $_4Be^8$, the emitted particles will be
(a) neutrons (b) alpha particles
(c) beta particles (d) gamma photons

5. The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?



(a) 1.33 A (b) 1.71 A
(c) 2.00 A (d) 2.31 A

6. Two electrons of kinetic energy 2.5 eV fall on a metal plate, which has work function of 4.0 eV. Number of electrons ejected from the metal surface is
(a) one (b) two
(c) zero (d) more than two

7. The binding energies of the atoms of elements A and B are E_a and E_b respectively. Three atoms of the element B fuse to give one atom of element A. This fusion process is accompanied by release of energy e. Then E_a, E_b and e are related to each other as
(a) $E_a + e = 3E_b$ (b) $E_a = 3E_b$
(c) $E_a - e = 3E_b$ (d) $E_a + 3E_b + e = 0$

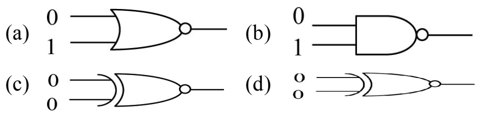
8. What is the ratio of the circumference of the first Bohr orbit for the electron in the hydrogen atom to the de-Broglie wavelength of electrons having the same velocity as the electron in the first Bohr orbit of the hydrogen atom?
(a) 1 : 1 (b) 1 : 2
(c) 1 : 4 (d) 2 : 1

9. In the X-ray tube before striking the target we accelerate the electrons through a potential difference of V volt. For which of the following value of V, we will have X-rays of largest wavelength?
(a) 10 kV (b) 20 kV
(c) 30 kV (d) 40 kV

10. The electron emitted in beta radiation originates from
(a) inner orbits of atoms
(b) free electrons existing in nuclei
(c) decay of neutron in a nucleus
(d) photon escaping from the nucleus

11. A p-type semiconductor has acceptor level 57 meV above the valence band. The maximum wavelength of light required to create a hole is
(a) 57 Å (b) 57×10^{-3} Å
(c) 217100 Å (d) 11.61×10^{-33} Å.

12. Which of the following gates will have an output of 1?



13. Two radioactive substances X and Y initially contain equal number of nuclei. X has a half life of 1 hour and Y has half life of 2 hours. After two hours the ratio of the activity of X to the activity of Y will be
(a) 1 : 4 (b) 1 : 2
(c) 1 : 1 (d) 2 : 1

14. The energy spectrum of a black body exhibits maximum around a wavelength λ_0. The temperature of the black body is now changed such that the energy is maximum around a wavelength $\frac{3\lambda_0}{4}$. The power radiated by the black body will now increase by a factor of
(a) $\frac{256}{81}$ (b) $\frac{64}{27}$
(c) $\frac{16}{9}$ (d) $\frac{4}{3}$

15. The binding energy per nucleon of deuteron ($_1H^2$) and helium nucleus ($_2He^4$) are 1.1 MeV and 7 MeV respectively. If two deuteron nuclei react to form a single helium nucleus, then energy released is
(a) 13.9 MeV (b) 26.9 MeV
(c) 23.6 MeV (d) 19.2 MeV

16. The electromagnetic waves that has highest wavelength is
(a) X-rays (b) Ultraviolet rays
(c) Infra-red rays (d) Microwaves

17. In a transistor, the emitter-base junction and the collector-base junction are:
(a) forward and forward biased respectively
(b) reverse and reverse biased respectively
(c) reverse and forward biased respectively
(d) forward and reverse biased respectively

18. The ratio of de-Broglie wavelength of molecules of hydrogen and helium which are at temperatures 27°C and 127°C respectively will be
(a) $\sqrt{\frac{4}{3}}$ (b) $\sqrt{\frac{8}{3}}$
(c) $\sqrt{\frac{3}{8}}$ (d) $\sqrt{\frac{3}{4}}$

19. A proton with kinetic energy K describes a circle of radius r in a uniform magnetic field. An α-particle with kinetic energy K moving in the same magnetic field will describe a circle of radius
(a) $\frac{r}{2}$ (b) r
(c) $2r$ (d) $4r$

20. An electron of mass m and charge e is accelerated by a potential difference V. It then enters a uniform magnetic field B applied perpendicular to its path. The radius of the circular path of the electron is

(a) $r=\left(\frac{2mV}{eB^2}\right)^{\frac{1}{2}}$ (b) $r=\left(\frac{2meV}{B^2}\right)^{\frac{1}{2}}$

(c) $r=\left(\frac{2mB}{eV^2}\right)^{\frac{1}{2}}$ (d) $r=\left(\frac{2B^2V}{em}\right)^{\frac{1}{2}}$

21. If the binding energy per nucleon in ${}^7_3Li$ and ${}^4_2He$ nuclei are 5.60 MeV and 7.06 MeV respectively, then in the reaction ${}^1_1H+{}^7_3Li\to 2{}^4_2He$ energy of proton must be

(a) 39.2 MeV (b) 28.24 MeV
(c) 17.28 MeV (d) 1.46 MeV

22. A photosensitive metallic surface has work function $h\nu_0$. If photons of energy $2h\nu_0$ falls on this surface, the electrons come out with a maximum velocity of 4×10^6 m/s. When the photon energy is increased to $5h\nu_0$, then maximum velocity of photoelectrons will be:

(a) 2×10^6 m/s (b) 2×10^7 m/s
(c) 8×10^7 m/s (d) 8×10^6 m/s

23. In hydrogen like atoms the ratio of difference of energies $E_{2n}-E_n$ and $E_{4n}-E_{2n}$ varies with atomic number z and principle quantum number n as

(a) $\frac{z^2}{n^2}$ (b) $\frac{z^4}{n^4}$

(c) $\frac{z}{n}$ (d) none of these

24. A hydrogen atom is in an excited state of principle quantum number n. It emits a photon of wavelength λ when returns to the ground state. The value of n is (R = Rydberg constant)

(a) $\sqrt{\lambda R(\lambda R-1)}$ (b) $\sqrt{\frac{(\lambda R-1)}{\lambda R}}$

(c) $\sqrt{\frac{\lambda R}{\lambda R-1}}$ (d) $\sqrt{\lambda(R-1)}$

25. An X-ray tube is operating at 2 million-volts. What is the wavelength of shortest wave produced?

(a) 6×10^{-3} m (b) 6×10^{-5} m
(c) 6×10^{-1} m (d) None of these

26. The longest wavelength that a single ionized helium atom in its ground state will absorb is

(a) 912 Å (b) 304 Å
(c) 229 Å (d) 687 Å

27. A sample contains 16 g of a radioactive material, the half-life of which is 2 days. After 32 days the amount of radioactive material left in the sample is

(a) Less than 1 *mg* (b) (1/4) *g*
(c) (1/2) *g* (d) 1 *g*

28. A freshly prepared radioactive source half-life 2hr emits radiation of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is

(a) 6 hr (b) 12 hr
(c) 42 hr (d) 128 hr

29. If the deBroglie wavelength of a proton is 1.0×10^{-13}m, the electric potential through which it must have been accelerated is

(a) 4.07×10^4 V (b) 8.2×10^4 V
(c) 8.2×10^3 V (d) 4.07×10^5 V

30. If proton and α-particles are accelerated by the same potential difference, then their De-Broglie wavelength will be in the ratio of

(a) $\sqrt{2}$ (b) 2
(c) $2\sqrt{2}$ (d) 4

31. If the maximum kinetic energy of emitted photo electrons from a metal surface of work function 2.5 *eV*, is 1.7 *eV*. If wavelength of incident radiation is halved, then stopping potential will be

(a) 2.5 V (b) 5.9 V
(c) 5 V (d) 1.1 V

32. If photons of energy 12.75 *eV* are passing through hydrogen gas in ground state then no. of lines in emission spectrum will be

(a) 6 (b) 4
(c) 3 (d) 2

33. An x-ray tube operating at 30 kV, will emit x-ray of minimum wavelength

(a) 2840 Å (b) 0.414 Å
(c) 2.14 Å (d) 1.78 Å

34. The half life of a radioactive element ${}^{222}R_u$ is 3.8 hrs. Mass of this element which has activity equal to 10^{16} Rutherford is

(a) 0.37 kg (b) 0.37 g
(c) 0.073 g (d) 0.07g

35. In a common base transistor $i_c=19i_b$, load and plate resistance are $4k\Omega$ and $1k\Omega$. The voltage gain of amplifier will be

(a) 80 (b) 4.2
(c) 3.8 (d) 76

36. If the shortest wavelengths of the continuous spectrum coming out of a Coolidge tube is 0.1Å, then the de Broglie wavelength of the electron reaching the target metal in the Coolidge tube is approximately (hc = 12400 eVÅ, $h = 6.63 \times 10^{-34}$ in MKS, mass of electron = 9.1×10^{-31} kg)

(a) 0.35 Å (b) 0.035 Å
(c) 35 Å (d) 1 Å

37. An electron collides with a fixed hydrogen atom in its ground state. Hydrogen atom gets excited and the colliding electron loses all its kinetic energy. Consequently the hydrogen atom may emit a photon corresponding to the largest wavelength of the Balmer series. The minimum kinetic energy of colliding electron is

(a) 10.2 eV (b) 1.9 eV
(c) 12.09 eV (d) 13.6 eV

38. A radiation of energy E falls normally on a perfectly absorbing surface. The momentum transferred to the surface is

(a) $\frac{E}{c}$ (b) $\frac{2E}{c}$

(c) Ec (d) $\frac{E}{c^2}$

39. A transistor is used in common-emitter mode as an amplifier. Then

(a) the base-collector junction is forward biased
(b) the base emitter junction is reversed biased
(c) the input signal is connected in series with the voltage applied to the base-emitter junction
(d) the input signal is connected in series with the voltage applied to the base-collector junction.

40. The current gain of a transistor in common emitter circuit is 40. The ratio of emitter current to base current is

(a) 40 (b) 41
(c) 42 (d) 43

41. A lead ball moving with velocity v strikes a wall and stops. If 50% of its energy is converted into heat, then what will be the increase in temperature? (Specific heat of lead is s)

(a) $\frac{2v^2}{Js}$ (b) $\frac{v^2}{4Js}$

(c) $\frac{v^2s}{J}$ (d) $\frac{v^2s}{2J}$

42. If doubly ionized lithium atom is hydrogen like with atomic number 3, the wavelength of radiation required to excite the electron in Li^{++} from the first to the third Bohr orbit and the number of different spectral lines observed in the emission spectrum of the above excited system are

(a) 296 Å, 6 (b) 114 Å, 3
(c) 1026 Å,6 (d) 8208 Å, 3

43. The ratio of de Broglie wavelength of α-particle to that of a proton being subjected to the same magnetic field so that the radii of their paths are equal to each other assuming the field induction vector $\vec{B}$ is perpendicular to the velocity vectors of the α-particle and the proton is

(a) 1 (b) 1/4
(c) 1/2 (d) 2

44. The ratio (in SI units) of magnetic dipole moment to that of the angular momentum of electron of mass m kg and charge e coulomb in Bohr's orbit of hydrogen atom is

(a) $\frac{e}{22m}$ (b) $\frac{e}{6m}$
(c) $\frac{12e}{m}$ (d) none of these

45. The speed of an electron having a wavelength of the order of 1Å will be

(a) 7.25×10^6 m/s (b) 6.26×10^6 m/s
(c) 5.25×10^6 m/s (d) 4.24×10^6 m/s

46. An electromagnetic wave going through vacuum is described by $E = E_0 \sin(kx - \omega t)$; $B = B_0 \sin(kx - \omega t)$. Which of the following equation is true?

(a) $E_0 k = B_0 \omega$ (b) $E_0 \omega = B_0 k$
(c) $E_0 k_0 = \omega k$ (d) none of these

47. The number densities of electrons and holes in a pure germanium at room temperature are equal and its value is 3×10^{16} per m^3. On doping with aluminium, the hole density increases to 4.5×10^{22} per m^3. Then the electron density in doped germanium is

(a) 2.5×10^{10} m^{-3} (b) 2×10^{10} m^{-3}
(c) 4.5×10^9 m^{-3} (d) 3×10^9 m^{-3}

48. The energy that should be added to an electron, to reduce its de-Broglie wavelengths from 10^{-10}m to 0.5×10^{-10} m, will be

(a) four times the initial energy
(b) thrice the initial energy
(c) equal to the initial energy
(d) twice the initial energy

49. The input resistance of a CE amplifier is 333 Ω and the load resistance is 5kΩ. A change of base current by 15μA results in the change of collector current by 1 mA. The voltage gain of the amplifier is

(a) 550 (b) 101
(c) 1001 (d) 501

50. A common emitter amplifier is designed with NPN transistor (α = 0.99). The input impedance is 1 kΩ and load is 10 kΩ. The voltage gain will be

(a) 9.9 (b) 99
(c) 990 (d) 9900

51. A proton of mass m and charge +e is moving in a circular orbit in a magnetic field with energy 1 MeV. What should be the energy of α- particle (mass = 4m and charge = +2e), so that it can revolve in the path of same radius

(a) 1 MeV (b) 4 MeV
(c) 2 MeV (d) 0.5 MeV

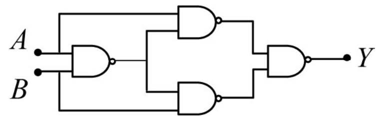
52. In NPN transistor the collector current is 10 mA. If 90% of electrons emitted reach the collector, then

(a) emitter current will be 9 mA
(b) emitter current will be 11.1 mA
(c) base current will be 0.1 mA
(d) base current will be 0.01 mA

53. In an electromagnetic wave, the electric and magnetizing fields are 100 Vm^{-1} and 0.265 Am^{-1}. The maximum energy flow is

(a) 26.5 W/m^2 (b) 36.5 W/m^2
(c) 46.7 W/m^2 (d) 765 W/m^2

54. Select the outputs Y of the combination of gates shown below for inputs A = 1, B = 0; A = 1, B = 1 and A = 0, B = 0 respectively:



(a) (0 0 1) (b) (1 0 1)
(c) (1 1 1) (d) (1 0 0)

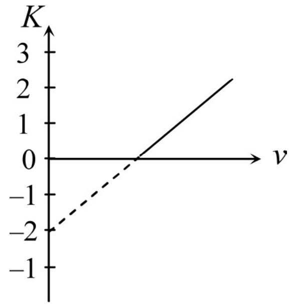
55. The speed of an electron having a wavelength of the order of 1Å will be

(a) 7.25×10^6 m/s (b) 6.26×10^6 m/s
(c) 5.25×10^6 m/s (d) 4.24×10^6 m/s

56. In a photoelectric experiment, the wavelength of incident radiation is reduced from 6000Å to 4000Å then

(a) Stopping potential will decrease
(b) Stopping potential will increase
(c) Kinetic energy of emitted electrons will decrease
(d) The value of work function will decrease

57. Figure represents the graph of kinetic energy (K) of photoelectrons (in eV) and frequency (ν) for a metal used as cathode in photoelectric experiment. The work function of metal is



(a) 1 eV (b) 1.5 eV
(c) 2 eV (d) 3 eV

58. As per Bohr model, the minimum energy (in eV) required to remove an electron from the ground state of doubly ionized Li and (Z = 3) is

(a) 1.51 (b) 13.6
(c) 40.8 (d) 122.4

59. In Bohr's model, the atomic radius of the first orbit is r_0, then the radius of the third orbit is

(a) $\frac{r_0}{9}$ (b) r_0
(c) $9r_0$ (d) $3r_0$

60. A common emitter amplifier is designed with NPN transistor (α = 0.99). The input impedance is 1 kΩ and load is 10 kΩ. The voltage gain will be

(a) 9.9 (b) 99
(c) 990 (d) 9900

61. A particle of mass $3m$ at rest decays into two particles of masses m and $2m$ having non-zero velocities. The ratio of the de-Broglie wavelengths of the particles (λ_1/λ_2) is

(a) 1/2 (b) 1/4
(c) 2 (d) none of these

62. In a photoelectric effect experiment

(a) on increasing intensity and keeping frequency fixed the saturation current decreases
(b) on increasing intensity and keeping frequency fixed the saturation current remains constant
(c) on increasing intensity, saturation current may increase
(d) on increasing frequency saturation current may increase

63. The wavelength of the K_α line for the uranium atom (Z = 92) is (R =10^7 m^{-1})
(a) 1.6Å (b) 0.16Å
(c) 0.5Å (d) 2.0Å

64. As per Bohr model, the minimum energy (in eV) required to remove an electron from the ground state of doubly ionized Li and (Z = 3) is
(a) 1.51 (b) 13.6
(c) 40.8 (d) 122.4

65. In a pure silicon (n_i = 10^{16} /m^3) crystal at 300 K, 10^{21} atoms of phosphorus are added per cubic meter. The new hole concentration will be
(a) 10^{21} per m^3 (b) 10^{19} per m^3
(c) 10^{11} per m^3 (d) 10^5 per m^3

66. The de-Broglie wavelength of a particle moving with a velocity 2.25 × 10^8 m/s is equal to the wavelength of photon. The ratio of kinetic energy of the particle to the energy of the photon is (velocity of light is 3 × 10^8 m/s)
(a) 1/8 (b) 3/8
(c) 5/8 (d) 7/8

67. When a certain metallic surface is illuminated with monochromatic light of wavelength λ, the stopping potential for photoelectric current is $3V_0$. When the same surface is illuminated with the light of wavelength 2λ, the stopping potential is V_0. The threshold wavelength for the surface for photoelectric effect is
(a) $\frac{4\lambda}{3}$ (b) 4λ
(c) 6λ (d) 8

68. In the hydrogen atom spectrum, λ_{3-1} and λ_{2-1} represent wavelengths emitted due to transition from second and first excited states to the ground state respectively. The value of $\frac{\lambda_{3-1}}{\lambda_{2-1}}$ is
(a) $\frac{27}{32}$ (b) $\frac{32}{27}$
(c) $\frac{4}{9}$ (d) $\frac{9}{4}$

69. The work function of aluminium is 4.2 eV. If two photons, each of energy 3.5 eV strike an electron of aluminium, then emission of electrons will be
(a) possible
(b) not possible
(c) data is incomplete
(d) depend upon the density of the surface

70. An electron and a proton are separated by a large distance. The electron starts approaching the proton with energy 2eV. The proton captures the electron and forms a hydrogen atom in first excited state. The resulting photon is incident on a photosensitive metal of threshold wavelength 4600Å. The maximum K.E. of the emitted photoelectron is (Take hc = 12420 eV Å)
(a) 2.4 eV (b) 2.7 eV
(c) 2.9 eV (d) 5.4 eV

71. Two radioactive elements R and S disintegrate as

$R \longrightarrow P+\alpha$; $\lambda_R = 4.5\times10^{-3}$ years $^{-1}$

$S \longrightarrow Q+\beta$; $\lambda_S = 3\times10^{-3}$ years $^{-1}$

Starting with number of atoms of R and S in the ratio of 2 : 1, this ratio after the lapse of three half lives of R will be
(a) 3: 2 (b) 1: 3
(c) 1 : 1 (d) 2 : 1

72. An electron in hypothetical hydrogen atom is in its 3rd excited state and makes transition from 3rd to 2nd excited, then to 1st excited state and then to ground state. If the amount of time spent by the electron in any state of quantum number n, is proportional to $\left(\frac{1}{n-1}\right)$, then the ratio of no. of revolutions completed by the electron in 1st excited state to that in the 2nd excited state will be
(a) 2 (b) $\frac{27}{8}$
(c) $\frac{27}{4}$ (d) $\frac{27}{6}$

73. In an X-ray set up accelerating potential difference is set at V volt and first a target metal having atomic no. Z_1 is used then target metal having Z_2 is used (λ_{α_1} is wavelength of K_α X–ray from Z_1 target and λ_{α_2} is wavelength of K_α, x-ray with Z_2 target)
(a) If $Z_1 > Z_2$ then $(\lambda_{\alpha_1} - \lambda_{min}) > (\lambda_{\alpha_2} - \lambda_{min})$
(b) If $Z_1 < Z_2$ then $(\lambda_{\alpha_1} - \lambda_{min}) > (\lambda_{\alpha_2} - \lambda_{min})$
(c) The difference $(\lambda_{\alpha_1} - \lambda_{min})$ and $(\lambda_{\alpha_{12}} - \lambda_{min})$ will be same for both the target metals
(d) If $Z_1 \le Z_2$ then $(\lambda_{\alpha_1} - \lambda_{min}) \le (\lambda_{\alpha_2} - \lambda_{min})$

74. The minimum kinetic energy of proton incident on ${}^{13}_{6}C$ nuclei at rest that will produce the reaction ${}^{13}C(p,n){}^{13}N$ is (Mass of nitrogen = 13.005738 amu, Mass of neutron = 1.008665 amu, Mass of carbon = 13.005738 amu Mass of proton = 1.007825 amu)
(a) 0.02 MeV (b) 0.10 MeV
(c) 0.03 MeV (d) 0.05 MeV

75. The wavelength corresponding to maximum spectral radiancy of a black body A is λ_A = 5000Å. Consider another black body B, whose surface area is twice that of A and total radiant energy by B is 16 times that emitted by A. The wavelength corresponding to maximum spectrum radiancy for B will be
(a) 5000 $(2)^{3/4}$ Å (b) 2500 Å
(c) 10,000 Å (d) 5000 $(2)^{-3/4}$ Å

76. An electron collides with a fixed hydrogen atom in its ground state. Hydrogen atom gets excited and the colliding electron loses all its kinetic energy. Consequently the hydrogen atom may emit a photon corresponding to the largest wavelength of the Balmer series. The minimum kinetic energy of colliding electron is
(a) 10.2 eV (b) 1.9 eV
(c) 12.09 eV (d) 13.6 eV

77. Electromagnetic radiation whose electric component varies with time as
$E = C_1(C_2 + C_3\cos\omega t)\cos\omega_0 t$, here C_1, C_2 and C_3 are constants, is incident on lithium and librates photoelectrons. If the kinetic energy of most energetic electrons be 0.592×10^{-19} J. Given that ω_0 = 3.6 × 10^{15} rad/sec and ω = 6 × 10^{14} rad/sec. The work function of lithium is (take planks constant h = 6.6 × 10^{-34} MKS).
(a) 1.2 eV (b) 1.5 eV
(c) 2.1 eV (d) 2.39 eV

78. In hydrogen atom, if potential energy of electron in ground state is assumed to be zero, then its energy in first excited state is equal to
(a) – 3.4 eV (b) 23.8 eV
(c) 17.2 eV (d) – 6.8 eV

79. The wavelength of characteristic K_α-line emitted by a hydrogen like element is 0.32 Å. The wavelength of the K_β -line emited by the same element will be
(a) 0.25 Å (b) 0.27 Å
(c) 0.30 Å (d) 0.35 Å

80. The mean lives of a radioactive sample are 30 years and 60 years for α-emission and β-emission respectively. If the sample decays both by α-emission and β-emission simultaneously, the time after which, only one-fourth of the sample remain is
(a) 10 years (b) 20 years
(c) 40 years (d) 45 years

81. An electron and a proton are separated by a large distance. The electron starts approaching the proton with energy 2eV. The proton captures the electron and forms a hydrogen atom in first excited state. The resulting photon is incident on a photosensitive metal of threshold wavelength 4600Å. The maximum K.E. of the emitted photoelectron is (hc = 12420 eV Å)

(a) 2.4 eV (b) 2.7 eV
(c) 2.9 eV (d) 5.4 eV

82. If the shortest wavelengths of the continuous spectrum coming out of a Coolidge tube is 0.1Å, then the de Broglie wavelength of the electron reaching the target metal in the Coolidge tube is approximately (hc = 12400 eVÅ, $h = 6.63 \times 10^{-34}$ in MKS, mass of electron = 9.1×10^{-31} kg)

(a) 0.35 Å (b) 0.035 Å
(c) 35 Å (d) 1 Å

83. A radioactive nucleus decays according to following series

$$X \xrightarrow{\alpha} X_1 \xrightarrow{\beta} X_2 \xrightarrow{\alpha} X_3 \xrightarrow{\gamma} X_4$$

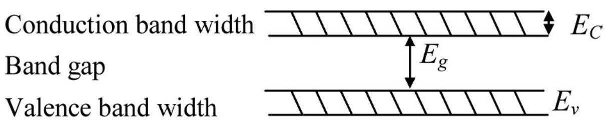
If the atomic number and atomic weight of the parent element X are 72 and 180 respectively, then the atomic number and atomic mass of X_4 are respectively

(a) 70, 172 (b) 69, 171
(c) 69, 172 (d) 68, 172

84. The 'rad' is the correct unit used to report the measurement of

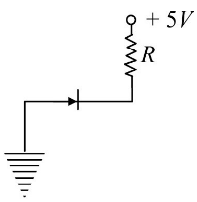
(a) the rate of decay of radioactive source
(b) the ability of a beam of gamma ray photons to produce ions in a target
(c) the energy delivered by radiation to a target.
(d) the biological effect of radiation.

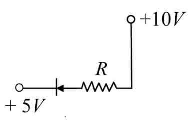
85. If the lattice constant of this semiconductor is decreased, then which of the following is correct?

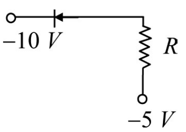


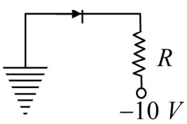
(a) All E_c, E_g, E_v decrease
(b) All E_c, E_g, E_v increase
(c) E_c, and E_v increase but E_g decrease
(d) E_c, and E_v, decrease E_g increase

86. In the following, which one of the diodes is reverse biased?

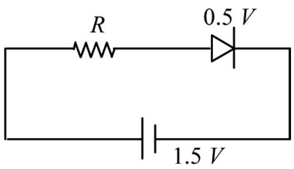
(a) 

(b) 

(c) 

(d) 

87. A diode used in the circuit shown has constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milli-watts. What should be the value of the resistor R, connected in series with the diode to obtain maximum current ?



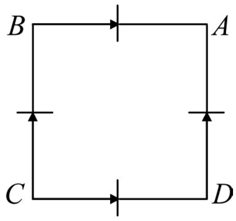
(a) 5 Ω (b) 5.6
(c) 6.76 Ω (d) 20 Ω

88. In certain element the K-shell electron energy is – 18.525 keV and the L-shell electron energy is – 3 keV. When an electron jumps from the L-shell to K shell, an X-ray photon is emitted. The wavelength of the emitted X-rays is

89. In an ore containing uranium, the ratio of U^{238} to Pb^{206} nuclei is 3. The age of the ore, assuming that all the lead present in the ore is the final stable product of U^{238} is (Take the half-life of U^{238} to be 4.5×10^9 years, ln 2 = 0.7, ln 3 = 1.1)

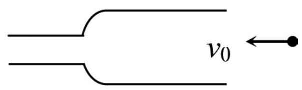
(a) 1.95×10^9 years (b) 1.95×10^{10} years
(c) 1.95×10^8 years (d) 1.95×10^7 years

90. If the given circuit is to act as a full-wave rectifier, the input and output terminals should be respectively



(a) (B, D) and (A, C) (b) (A, C) and (B, D)
(c) (B, C) and (A, D) (d) None of these

91. An electron moves along a metal tube with variable –section. The velocity of the electron when it approaches the neck of tube, is



(a) greater than v_0 (b) equal to v_0
(c) less than v_0 (d) not defined

92. In a hydrogen atom, an electron of mass m and charge e is in an orbit of radius r making n revolutions per second. If the mass of the hydrogen nucleus is M , the magnetic moment associated with the orbital motion of the electron is

(a) $\dfrac{\pi ner^2 m}{M}$ (b) $\dfrac{\pi ner^2 M}{m}$

(c) $\dfrac{\pi ner^2 m}{(M+m)}$ (d) πner^2

93. The threshold frequency for a metallic surface corresponds to an energy of 6.2 eV, and the stopping potential for a radiation incident on this surface 5 V. The incident radiation lies in

(a) X-ray region (b) ultra-violet region
(c) infra-red region (d) visible region

94. The electric potential between a proton and an electron is given by $V = V_0 \ln \dfrac{r}{r_0}$, where r_0 is a constant. Assuming Bohr's model to be applicable, then variation of r_n with n, where n being the principal quantum number is

(a) $r_n \propto n$ (b) $r_n \propto \dfrac{1}{n}$

(c) $r_n \propto n^2$ (d) $r_n \propto \dfrac{1}{n^2}$

95. Nuclei of a radioactive element A are being produced at a constant rate α. The element A has a decay constant λ. At time t = 0, there are N_0 nuclei of the element A. The number N of nuclei of A at time t is

(a) $\dfrac{1}{\lambda}[\alpha - (\alpha - \lambda N_0)e^{-\lambda t}]$

(b) $\dfrac{1}{\lambda}[(\alpha - \lambda N_0)e^{-\lambda t}]$

(c) $\lambda[\alpha - (\alpha - \lambda N_0)e^{\lambda t}]$

(d) $\lambda N_0 e^{-\lambda t}$

96. There are two radioactive nuclei A and B. A is an alpha emitter and B is a beta emitter. If their disintegration constants are in the ratio 1 : 2, then the ratio of number of atoms of A and B at any time t so that probabilities of getting alpha and beta particles are same at that instant

(a) 2 : 1 (b) 1 : 2
(c) e (d) e^{-1}

97. The radius of hydrogen atom in its ground state is 5.3×10^{-11} m. After collision with an electron it is found to have a radius of 21.2×10^{-11} m. What is the principal quantum number n of the final state of the atom?

(a) $n = 4$ (b) $n = 2$
(c) $n = 16$ (d) $n = 3$

98. The wavelength of the characteristic X-ray K_α line emitted by a hydrogen-like element is 0.32 Å. The wavelength of K_β line emitted by the same element will be

(a) 0.24 Å (b) 0.27 Å
(c) 0.32 Å (d) 0.48 Å

99. Electrons in hydrogen atom revolve in radius 0.53 Å (in ground state). Due to collision, electron starts revolving in radius of 4.77 Å. Change in angular momentum of the electron will be equal to

(a) 2.11×10^{-36} kg m^2/sec
(b) 4.22×10^{-30} g m^2/sec
(c) 2.11×10^{-27} g cm^2/sec
(d) 4.22×10^{-36} kg m^2/sec

100. A radioactive material has half life's for α and β emission equal to 20 and 100 yrs respectively. $\frac{1}{8}$ th fraction of the radioactive material will be remain there after

(a) 360 yrs (b) 50 yrs
(c) 120 yrs (d) 180 yrs

101. Choose the incorrect statement

(a) current gain is more in case of common emitter as compared to common base
(b) base junction tried to controls current
(c) high power is generated in reverse biasing
(d) collector current is slightly less than emitter current

102. When photons of energy 4.25 eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy T_A eV and de Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.70 eV is $T_B = (T_A - 1.50)$ eV. If the de Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$, then choose the incorrect statement.

(a) the work function of A is 1.25 eV
(b) the work function of B is 4.20 eV
(c) $T_A = 2.00$ eV
(d) $T_B = 0.5$ eV

103. An electron in H-atom jumps from second excited state to first excited state and then from first excited to ground state. Let the ratio of wavelength, momentum and energy of photons emitted in these two cases be a, b and c respectively. Then, choose the incorrect answer:

(a) $c = \frac{1}{a}$ (b) $a = \frac{9}{4}$
(c) $b = \frac{5}{27}$ (d) $c = \frac{5}{27}$

104. The wavelength corresponding to maximum spectral radiancy of a black body A is $\lambda_A = 5000$Å. Consider another black body B, whose surface area is twice that of A and total radiant energy by B is 16 times that emitted by A. The wavelength corresponding to maximum spectrum radiancy for B will be

(a) $5000\ (2)^{3/4}$ Å (b) 2500 Å
(c) 10,000 Å (d) $5000\ (2)^{-3/4}$ Å

105. Suppose potential energy between electron and proton at separation r is given by $U = k \ln r$, where k is constant. For such hypothetical hydrogen atom, the ratio of energy difference between energy levels ($n = 1$ and $n = 2$) and ($n = 2$ and $n = 4$) is

(a) 1 (b) 2
(c) $\frac{1}{2}$ (d) 3

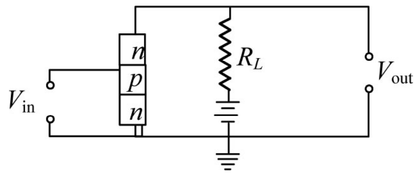
106. An electron and a proton are separated by a large distance. The electron starts approaching the proton with energy 2eV. The proton captures the electron and forms a hydrogen atom in first excited state. The resulting photon is incident on a photosensitive metal of threshold wavelength 4600Å. The maximum K.E. of the emitted photoelectron is (Take hc = 12420 eV Å)

(a) 2.4 eV (b) 2.7 eV
(c) 2.9 eV (d) 5.4 eV

107. Which of the following statements is wrong?

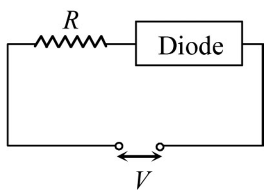
(a) The shortest wavelength of X-rays emitted from an X-ray tube depends on current in the tube.
(b) Characteristic X-ray spectra are simple as compare to optical spectra.
(c) X-ray can't be diffracted by means of an ordinary grating.
(d) There exists a sharp limit on the short wavelength side for each continuous X-ray spectrum.

108. An n-p-n transistor circuit is arranged as shown in figure. It is



(a) a common-base amplifier circuit
(b) a common-emitter amplifier circuit
(c) a common –collector amplifier circuit
(d) none of the above

109. For a given circuit of ideal p-n junction diode which of the following is correct?



(a) In forward biasing, the voltage across R is V
(b) In reverse biasing the voltage across R is V
(c) In forward biasing the voltage across R is $2V$
(d) In reverse biasing the voltage across R is $2V$

110. What would be the energy required to dissociate completely 1 gram of Ca-40 into its constituent particles?

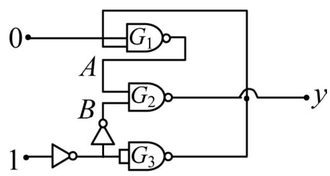
Mass of proton = 1.007277 amu

Mass of neutron = 1.00866 amu

Mass of Ca-40 = 39.97545 amu (Take one amu= 931 MeV)

(a) 4.843×10^{24} MeV (b) 4.813×10^{24} MeV
(c) 4.813×10^{22} MeV (d) none of these

111. For the combination of gates in following figure the value of Y is



(a) 0
(b) 1

(c) fluctuates between 0 and 1

(d) indeterminate as the circuit cannot be realized

112. The process of changing some characteristic of a carrier wave in accordance with the intensity of the signal is called

(a) amplification (b) rectification

(c) modulation (d) none of these

113. If no external voltage is applied across *P-N* junction, there would be

(a) no electric field across the junction

(b) an electric field pointing from *N*-type to *P*-type side across the junction

(c) an electric field pointing from *P*-type to *N*-type side across the junction

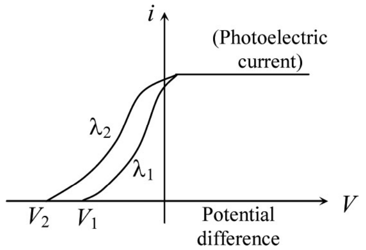
(d) A temporary electric field during formation of *P-N* junction that would subsequently disappear.

114. What is the conductivity of a semiconductor if electron density is 5×10^{12} per cm^3 and hole density is 8×10^{13} per cm^3. ($\mu_e = 2.3\ V^{-1}\ s^{-1}\ m^2$ and $\mu_h = 0.01\ V^{-1}s^{-1}m^2$)

(a) $5.634e^{-1}m^{-1}$ (b) $1.968\ \Omega^{-1}m^{-1}$

(c) $3.421\ \Omega^{-1}m^{-1}$ (d) $8.964\ \Omega^{-1}m^{-1}$

115. In the following diagram, the relation between λ_1 and λ_2 will be



(a) $\lambda_1 = \sqrt{\lambda_2}$ (b) $\lambda_1 < \lambda_2$

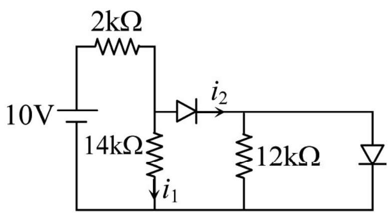
(c) $\lambda_1 = \lambda_2$ (d) $\lambda_1 > \lambda_2$

116. If α and β are the current gain in the *CB* and *CE* configurations respectively of the transistor circuit, then $\frac{\beta - \alpha}{\alpha\beta}$ is equal to

(a) ∞ (b) 1

(c) 2 (d) 0.5

117. In the following circuit I_1 and I_2 are respectively (diodes are ideal)



(a) 0, 0 (b) 5 mA, 5 mA

(c) 5 mA, 0 (d) 0, 5 mA

118. The area of region covered by the TV broadcast by a TV tower of 100 m height will be (radius of the earth = 6.4×10^6 m)

(a) $12.8\pi \times 10^8$ km^2 (b) $1.28\pi \times 10^3$ km^2

(c) $0.64\pi \times 10^3$ km^2 (d) 1.28×10^8 km^2

119. The binding energies per nucleon for a deuteron and an α-particle are x_1 and x_2 respectively. What will be the energy *Q* released in the reaction

$${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + Q$$

(a) $4(x_1 + x_2)$ (b) $4(x_2 - x_1)$

(c) $2(x_1 + x_2)$ (d) $2(x_2 - x_1)$

120. A star initially has 10^{40} deutrons. It produces energy via the processes

$${}_1H^2 + {}_1H^2 \rightarrow {}_1H^3 + p \text{ and } {}_1H^2 + {}_1H^3 \rightarrow {}_2He^4 + n.$$

If the average power radiated by the star is 10^{16} W, the deuteron supply of the star is exhausted in a time of the order of [The masses of nuclei are: m(H^2) = 2.014 u, m(p) = 1.007 u, m(n) = 1.008 u, m(He^4) = 4.001 u]

(a) 10^6 s (b) 10^8 s

(c) 10^{12} s (d) 10^{16} s

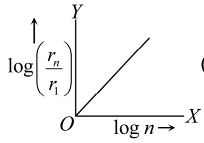
121. A sphere of density ρ, specific heat capacity *c* and radius *r*, is hung by a thermally insulated thread in an enclosure which is kept constant at a lower temperature than the sphere. The temperature of the sphere starts to drop at a rate which depends upon the temperature difference between the sphere and the enclosure and the nature of the surface of the sphere, and is proportional to

(a) $\frac{c}{r^3\rho}$ (b) $\frac{1}{r^3\rho c}$

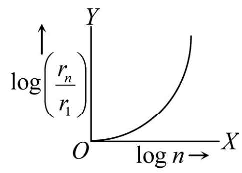
(c) $3r^3\rho c$ (d) $\frac{1}{r\rho c}$

122. In hydrogen atom, the radius of n^{th} Bohr's orbit is r_n. The graph between $\log\left(\frac{r_n}{r_1}\right)$ and log *n* will be

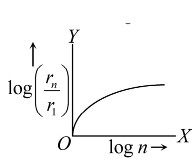
(a)



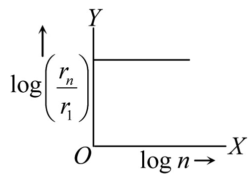
(b)



(c)



(d)



123. If l_1, l_2 and l_3 be the lengths of the emitter, base and collector of a transistor, then

(a) $l_1 = l_2 = l_3$ (b) $l_3 < l_2 > l_1$

(c) $l_3 < l_1 < l_2$ (d) $l_3 > l_1 > l_2$

124. A diatomic molecule having atoms of masses m_1 and m_2 has its potential energy function about the equilibrium position r_0 as given by $U(r) = -A + B(r - r_0)^2$ where *A* and *B* are constants. When the atom vibrate at high temperature condition, the square of angular frequency of vibration will be

(a) $\frac{2B}{m_1}$ (b) $\frac{2B}{m_2}$

(c) $\frac{2B(m_1 + m_2)}{m_1 m_2}$ (d) $\frac{B(m_1 + m_2)}{2m_1 m_2}$

125. Weins displacement law fails at

(a) high temperature (b) low temperature

(c) high wavelength (d) low wavelength